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TECHNICAL NOTE

RECORDING AND STORING DATA FOR YOKED-CONTROL COMPARISONS

The yoked-control design equates the distribution and frequency of certain events across conditions that vary in other ways. For example, Ferster and Skinner (1957) reinforced a pigeon's key pecking according to a variable-ratio schedule. These reinforcers simultaneously made available reinforcement following the next key peck of another pigeon in a second chamber. Thus, behavioral effects of the ratio schedule were isolated by controlling reinforcement frequency and distribution.

A simple and reliable device for arranging yoked controls is illustrated in Figure 1. It consists of a film reader (Ralph Gerbrands Company, model PT 1A) with the microswitch unit removed and an event pen assembly (A). The latter, taken from a Gerbrands C-3 cumulative recorder, also may be purchased separately. The event pen assembly was attached so that a nylon-tip pen (B) marked exposed 16-mm film as it was moved by the sprocket (C). Events appeared on the film as pen deflections. At the end of recording, holes were punched where deflections occurred, and the film was coded and stored. The sequence recorded on the film was "played back" during the yoked-control condition by a conventional film reader operating at the same speed as the recording film reader.

In one application, key pecking of two experimentally naive, White Carneaux pigeons was established under a multiple (mult) differential-reinforcement-of-low-rate (DRL) 20-sec DRL 20-sec schedule of food reinforcement. Components alternated every 240, 300, or 360 sec. When key pecking was stable, unsignaled delays were added in each component so that completing the DRL requirement initiated an unsignaled period that ended with reinforcement. In one component the delay was .5 sec and in the other it was 30 sec. Each reinforcer was recorded with the apparatus described. After 35 sessions of this condition and a return to the mult DRL 20-sec DRL 20-sec baseline for 20 to 30 sessions, response-independent reinforcers were delivered in both components according to variable-time (VT) schedules produced by the recorded films.

Figure 2 shows cumulative records for both pigeons under the three conditions. In unsignaled delay the event pen was down during the .5-sec delay and up during the 30-sec delay. Equivalent periods during yoked response-independent reinforcement are shown in the lower records for each bird. In general, .5-sec delays increased responding relative to the DRL baseline and 30-sec delays reduced responding. Response-independent reinforcement maintained lower rates than the DRL baseline or the .5 sec unsignaled delay. Unsignaled 30-sec delays and response-independent reinforcement maintained similar rates. The number and distribution of reinforcers in unsignaled delay and yoked response-independent reinforcement were identical for both birds, as indicated by the arrows, even though the sessions were separated by many days.

The apparatus has been used with a 1-mm per sec sprocket drive for over five months without malfunction. One limitation is the frequency of the events to be recorded. For example, very frequent events would require a high-speed sprocket drive, for without rapidly moving film the events would be too close to be punched separately.

While the procedure is equally suitable for within- and between-subject yoked controls, it seems especially useful for within-subject yoking where the experimental and yoked-control conditions are separated widely in time. Church (1964) argued that individual differences between experimental and yoked-control subjects could lead to errors in interpreting behavioral differences between conditions. He also suggested that moment-to-moment variability in the effectiveness of the independent variable can lead to systematic bias within individual subjects under either yoked-control or experimental conditions. The former problem (individual differences) is resolved if a single subject receives both the experimental and the yoked condition. Although the latter problem may exist, the demonstrated utility, power, and generality of within-subject comparisons in

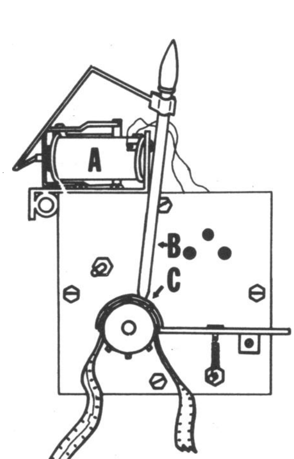

Fig. 1. Modified film reader used to record events for within-subject yoked-control comparisons. See text for details.

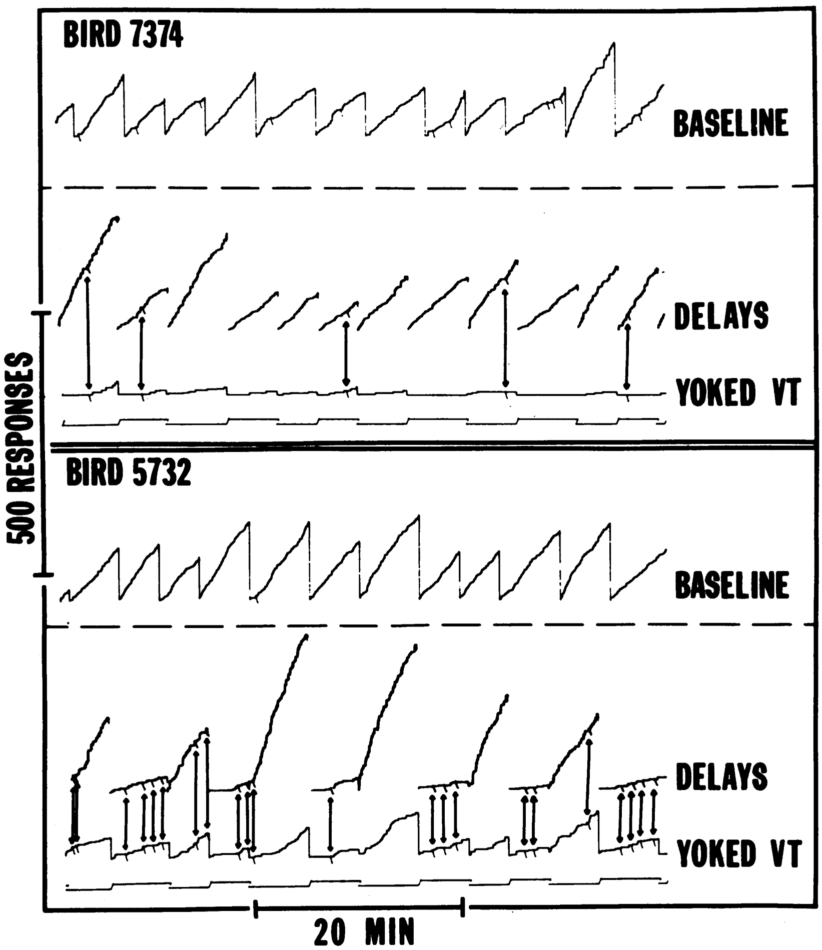

Fig. 2. Sample cumulative records from each pigeon under the multiple DRL 20-sec DRL 20-sec baseline (top), unsignaled delays (middle), and yoked response-independent reinforcement (bottom). The response pen reset at the end of each component. Deflections of the response pen indicate reinforcer deliveries. Corresponding reinforcers during unsignaled delay and yoked VT are indicated by arrows.

the experimental analysis of behavior lend credence to their value in the context of yoked-control designs.

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